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Source: *Public Health Reports (1896-1970)*, Vol. 38, No. 21 (May 25, 1923), pp. 1125-1138

Published by: Association of Schools of Public Health

Stable URL: <http://www.jstor.org/stable/4576752>

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PUBLIC HEALTH REPORTS

VOL. 38

MAY 25, 1923

No. 21

THE DISTRIBUTION OF MALARIA IN THE UNITED STATES AS INDICATED BY MORTALITY REPORTS.¹

By KENNETH F. MAXCY, Assistant Surgeon, United States Public Health Service.

The initiative for measures of suppression of malaria rests primarily with the State health officers in the territory concerned. The proportion of their administrative effort devoted to this disease is predicated, in part, upon knowledge as to the—

- (a) Distribution of malaria throughout the States;
- (b) The relative importance of the problem in each State; and
- (c) The natural trend (increase or decrease) of the disease in each State.

The purpose of this paper is to present the information on these points that is to be derived from an analysis of reported deaths.

Mortality statistics furnish the only means of measurement at present available to indicate the prevalence of this disease on a common basis in all the States involved,² and it is only within the last three or four years that they have become sufficiently complete to render them of comparative value. Five of the 15 States represented in this study are not yet in the registration area for deaths, but some of these no doubt soon will be. As reporting becomes more complete and medical diagnosis more exact, this source of information will become of increasing value. The results of an analysis at this time are tentative and may be considerably modified when data have been accumulated for a longer period of time.

¹ From Field Investigations of Malaria, United States Public Health Service.

² EDITORIAL NOTE.—In his approach to the problem, the author deals only with mortality data. It seems pertinent, however, to emphasize the fact that the real importance of malaria as a burden upon the public is not reflected in the mortality returns, however useful these may be in indicating the intensities of the geographic distribution. The economic significance of malaria in areas where it seriously prevails is disproportionately great in comparison with the actual loss of life attributed to this disease. The statement is probably true that malaria is the only disease of man (possibly excepting the African sleeping sickness) which can reach such proportions as to render an area actually uninhabitable. Fortunately, malaria does not exist in such intensity anywhere in the United States, but in certain areas it does act as a very potent deterrent of human endeavor and progress.

(A) THE DISTRIBUTION OF MALARIA THROUGHOUT THE STATES.

Common opinion holds that malaria is a disease generally distributed throughout the South. Although this may have been a generalization which was justified some years ago, those who have had opportunity to observe more closely in recent years are aware that the disease is becoming more and more restricted to certain localities, and that there are now large areas of land in the South which are relatively or entirely free from malaria. Moreover, where malaria still exists, its intensity varies. In some areas there is only a *low incidence*—an occasional imported case causing a local outbreak which quickly dies out. The disease does not survive the winter uniformly, but is repeatedly reintroduced from neighboring foci. A large majority of the population escapes the infection. In other areas there is a *moderate amount* of malaria. The density of *Anopheles quadrimaculatus* is sufficiently great and the number of unprotected human beings sufficiently large to form a carrier reservoir. The infection is propagated throughout the winter, year after year; but in any one year only a small proportion of the total population is affected. Finally, there are certain areas of *high prevalence*, where a considerable proportion of the population has the disease each year. Nowhere in this country, as far as information is at present available, does the disease reach the intensity which it manifests in certain tropical countries.

Within certain limitations, the reported deaths from malaria should furnish a rough indication of this uneven distribution of the disease in this country. The case fatality rate of malaria is low, about 0.5 per cent. A considerable number of cases may occur during the period of a year in a given locality without a death. On the other hand, many counties which are known to have no malaria problem may show one or several deaths from malaria during the period of a year, to be explained as cases imported from near-by or remote foci; or as inaccuracies in assigning the cause of death. For these reasons, a *low* mortality rate based on a single year is of no value; based on a series of years it is still of questionable significance. Mortality statistics can not be safely relied upon to show counties where the prevalence of malaria is *low*. Counties with a *moderate* or *high* incidence, on the contrary, should give evidence of this fact in showing a considerable number of deaths *attributed* to malaria year after year with more or less regularity.

For most of the States concerned, figures are now available which show the number of deaths from malaria reported by each county for at least the three years ended in 1921. In Table I the figures for each county have been averaged for this three-year period and then expressed in a ratio to the population. All counties having a *rate of*

1 per 10,000 population or less have been omitted, because rates as low as this are of questionable significance. Those counties having

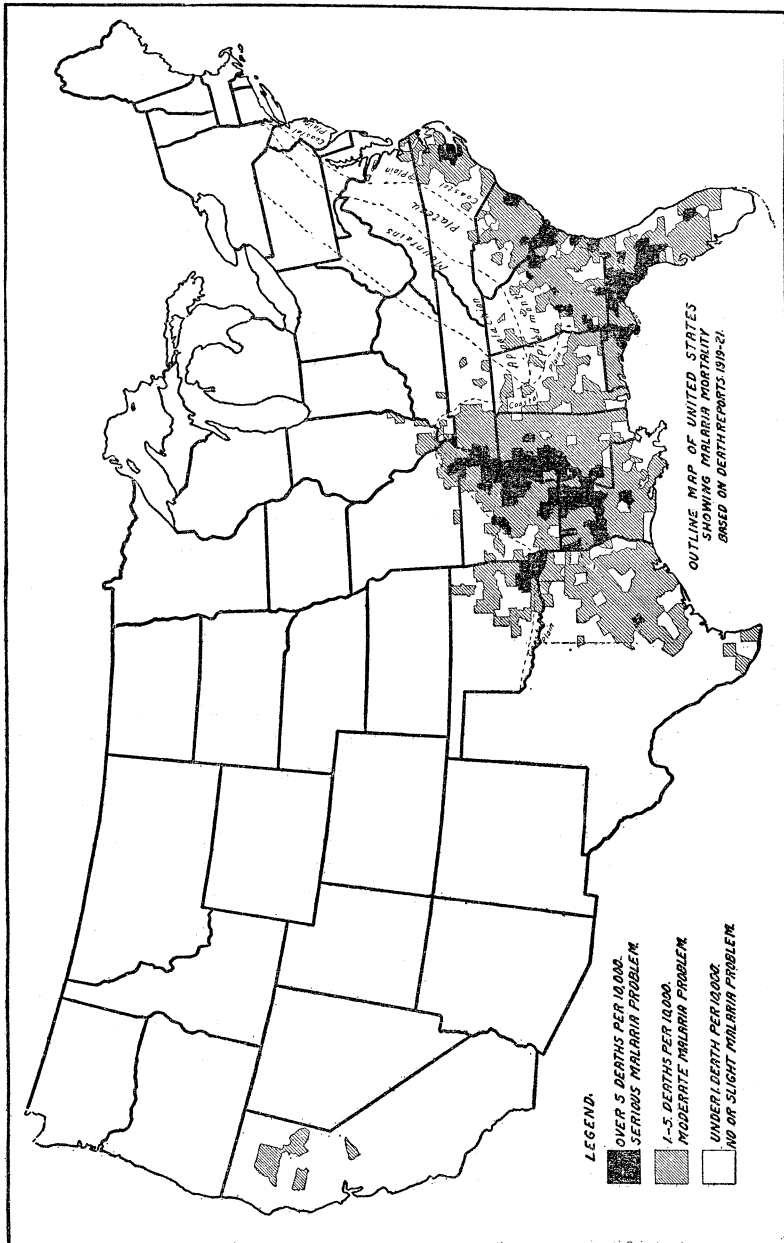


FIGURE 1.

an average rate of 5 per 10,000 population or more are indicated by an asterisk (*). This is an arbitrary separation of the counties with *high* from those of only *moderate* prevalence.

In Table II are shown the mortality rates for the counties of Georgia and Oklahoma. These were available only for the one year, 1921. The rates shown are consequently not as valuable as those of the States in Table I.

The data given in these two tables are presented in graphic form in Figure 1, showing the distribution of counties in the United States having a moderate or high incidence of malaria as indicated by mortality rates. This map does not show many counties with a low incidence and, therefore, does not present the complete picture of malaria distribution in this country. This deficiency is particularly noticeable in such States as Maryland, Virginia, Kentucky, and California. On the other hand, it contains many valuable suggestions.

It will be noted that malaria in the United States is largely confined to the Coastal Plain. In the East its extension is limited by the unfavorable topography of the Piedmont and mountain regions. It extends far up the broad, flat, Mississippi Valley, where it reaches its widest distribution. In the West its progress is checked by the arid plains of western Oklahoma and Texas.

TABLE I.—*List of counties having a malaria mortality rate in excess of 1 per 10,000 population for the three-year period 1919–1921, indicating a moderate to high incidence of the disease for that period.*

ALABAMA.		ARKANSAS.		ARKANSAS—continued.		FLORIDA.	
County.	Rate.	County.	Rate.	County.	Rate.	County.	Rate.
Autauga.....	1.1	Arkansas.....	*6.5	Lincoln.....	4.3	Alachua.....	4.1
Baldwin.....	1.5	Ashley.....	*10.3	Little River.....	*11.6	Baker.....	3.5
Barbour.....	2.2	Bradley.....	*5.0	Logan.....	1.2	Bay.....	*5.2
Bibb.....	1.3	Calhoun.....	*10.0	Lonoke.....	*11.1	Bradford.....	2.4
Bullock.....	1.6	Chicot.....	3.7	Miller.....	4.6	Calhoun.....	*5.7
Choctaw.....	1.9	Clark.....	2.7	Mississippi.....	*9.1	Citrus.....	*15.3
Clarke.....	1.1	Clay.....	*7.3	Monroe.....	*8.8	Columbia.....	3.5
Colbert.....	1.6	Cleburne.....	2.4	Nevada.....	1.4	De Soto.....	2.0
Crenshaw.....	1.3	Cleveland.....	2.4	Ouachita.....	4.3	Duval.....	1.2
Dale.....	1.3	Conway.....	*8.9	Perry.....	*7.1	Escambia.....	1.2
Dallas.....	1.8	Craighead.....	4.3	Phillips.....	*7.0	Franklin.....	2.0
Geneva.....	3.1	Crawford.....	2.3	Poinsett.....	*15.9	Gadsden.....	4.7
Greene.....	2.8	Crittenden.....	*5.1	Polk.....	1.8	Hamilton.....	*5.0
Hale.....	3.3	Cross.....	*5.4	Pope.....	1.5	Hernando.....	4.4
Henry.....	1.9	Dallas.....	4.2	Prairie.....	*10.3	Hillsborough.....	1.6
Houston.....	4.0	Desha.....	1.5	Pulaski.....	4.0	Holmes.....	4.7
Lamar.....	1.1	Drew.....	3.2	Randolph.....	1.7	Jackson.....	*10.6
Lawrence.....	1.6	Faulkner.....	4.0	Saline.....	1.8	Jefferson.....	*14.5
Lowndes.....	1.6	Garland.....	3.9	Sevier.....	*6.0	Lafayette.....	*17.6
Macon.....	1.3	Grant.....	4.0	St. Francis.....	*5.7	Lake.....	3.9
Marengo.....	1.7	Greene.....	1.5	Union.....	2.0	Leon.....	*11.1
Monroe.....	1.4	Hempstead.....	3.2	White.....	3.2	Levy.....	*15.0
Montgomery.....	1.2	Hot Spring.....	2.3	Woodruff.....	3.3	Liberty.....	4.0
Morgan.....	1.7	Independence.....	1.7			Madison.....	*10.0
Perry.....	1.6	Jackson.....	7.5	CALIFORNIA.		Manatee.....	2.6
Pickens.....	2.4	Jefferson.....	3.1	Calaveras.....	1.6	Marion.....	*6.3
Talladega.....	1.7	Lafayette.....	3.2	Glenn.....	1.7	Nassau.....	2.6
Walker.....	1.2	Lawrence.....	1.8	Plumas.....	1.8	Okaloosa.....	2.1
Washington.....	1.4	Lee.....	*5.2	Shasta.....	3.7	Okeechobee.....	*9.4

TABLE I.—*List of counties having a malaria mortality rate in excess of 1 per 10,000 population for the three-year period 1919–1921, indicating a moderate to high incidence of the disease for that period—Continued.*

FLORIDA—continued.		LOUISIANA—continued.		MISSISSIPPI—continued.		NORTH CAROLINA.	
County.	Rate.	Parish.	Rate.	County.	Rate.	County.	Rate.
Orange.....	2.5	Lincoln.....	2.4	Jefferson.....	*5.0	Beaufort.....	*5.8
Palm Beach.....	1.6	Madison.....	4.6	Jefferson Davis... 1.6		Bertie.....	2.1
Polk.....	2.3	Morehouse.....	*10.9	Jones.....	1.8	Brunswick.....	2.0
Putnam.....	2.0	Natchitoches.....	*8.5	Kemper.....	1.5	Carteret.....	1.9
St. Lucie.....	1.3	Ouachita.....	*7.6	Lafayette.....	3.6	Columbus.....	1.3
Santa Rosa.....	1.5	Plaquemines.....	1.1	Lauderdale.....	2.6	Craven.....	*7.6
Sumter.....	*6.4	Pointe Coupee.....	2.4	Lawrence.....	3.2	Cumberland.....	2.0
Suwanee.....	*8.6	Rapides.....	4.0	Leake.....	2.4	Currituck.....	1.4
Taylor.....	*17.8	Red River.....	3.9	Lee.....	1.4	Duplin.....	1.3
Wakulla.....	4.0	Richland.....	*9.1	Leflore.....	*10.0	Gates.....	1.9
Walton.....	1.7	Sabine.....	*6.3	Lincoln.....	1.6	Greene.....	1.2
Washington.....	2.5	St. Helena.....	1.2	Lowndes.....	1.8	Halifax.....	1.2
ILLINOIS.		St. John.....	2.5	Madison.....	2.4	Hyde.....	4.8
Alexander.....	2.5	St. Landry.....	*5.4	Marion.....	1.8	Jones.....	4.2
Gallatin.....	3.1	St. Martin.....	2.3	Marshall.....	2.7	Lenoir.....	1.4
Hardin.....	2.7	St. Mary.....	2.3	Monroe.....	2.2	Martin.....	1.9
Jackson.....	2.9	St. Tammany.....	1.5	Montgomery.....	2.9	New Hanover.....	1.5
Johnson.....	1.7	Tangipahoa.....	1.6	Neshoba.....	3.1	Northampton.....	4.3
Pulaski.....	2.7	Tensas.....	*7.5	Newton.....	1.5	Onslow.....	4.8
Union.....	2.0	Terrebonne.....	1.1	Noxubee.....	3.0	Pamlico.....	*10.0
Wabash.....	1.4	Union.....	*6.6	Oktibbeha.....	1.8	Pasquotank.....	1.1
Williamson.....	1.3	Vermilion.....	1.5	Panola.....	*6.5	Perquimans.....	1.8
KENTUCKY.		Vernon.....	1.5	Pearl River.....	1.3	Pitt.....	1.3
Carlisle.....	1.2	Washington.....	1.7	Perry.....	2.2	Union.....	1.4
Fulton.....	*8.6	Webster.....	*5.3	Pontotoc.....	4.0	Washington.....	1.8
Henderson.....	1.5	W. Baton Rouge... 1.8		Quitman.....	*17.6	Wayne.....	1.6
McCracken.....	1.3	W. Carroll.....	*7.9	Rankin.....	4.0	SOUTH CAROLINA.	
Marshall.....	2.6	W. Feliciana.....	3.2	Scott.....	2.4	Aiken.....	1.3
Todd.....	1.3	Winn.....	4.4	Sharkey.....	*10.6	Allendale.....	*5.0
LOUISIANA		MISSISSIPPI.		Simpson.....	2.2	Bamberg.....	*5.5
(Parishes)		County.		Smith.....	1.9	Barnwell.....	1.3
Acadia.....	1.4	Adams.....	3.1	Sunflower.....	*10.9	Beaufort.....	*5.0
Allen.....	1.6	Alcorn.....	1.9	Tallahatchie.....	*9.2	Berkeley.....	4.0
Ascension.....	1.3	Amite.....	2.1	Tate.....	4.1	Calhoun.....	3.8
Assumption.....	1.1	Attala.....	2.4	Tippah.....	3.9	Charleston.....	3.2
Avoyelles.....	1.4	Benton.....	2.0	Tishomingo.....	2.0	Clarendon.....	1.1
Beauregard.....	3.9	Bolivar.....	*8.3	Tunica.....	*13.8	Colleton.....	3.7
Bienville.....	2.9	Calhoun.....	*5.3	Union.....	4.0	Dorchester.....	2.6
Bossier.....	2.3	Carroll.....	*5.9	Washington.....	4.3	Edgefield.....	1.3
Caddo.....	*5.0	Chickasaw.....	2.7	Wayne.....	2.6	Florence.....	2.0
Calcasieu.....	2.1	Claiborne.....	4.6	Webster.....	4.0	Georgetown.....	*6.5
Caldwell.....	*8.4	Clarke.....	2.2	Wilkinson.....	3.3	Hampton.....	*7.7
Catahoula.....	*10.0	Clay.....	2.3	Winston.....	1.7	Horry.....	1.2
Claiborne.....	1.4	Coahoma.....	*11.4	Yalobusha.....	3.7	Jasper.....	5.1
Concordia.....	4.0	Copiah.....	2.1	Yazoo.....	*7.0	Kershaw.....	2.0
De Soto.....	3.8	Covington.....	2.0	MISSOURI.		Lancaster.....	1.7
E. Baton Rouge.. 1.6		De Soto.....	4.5	Butler.....	*7.1	Marion.....	1.3
E. Carroll.....	2.7	Forrest.....	1.9	Carter.....	1.3	Marlboro.....	2.4
E. Feliciana.....	1.1	Franklin.....	*5.0	Dunklin.....	*10.0	Newberry.....	1.1
Franklin.....	*10.8	George.....	1.8	Mississippi.....	3.9	Orangeburg.....	3.2
Grant.....	*7.6	Greene.....	2.9	New Madrid.....	2.4	Richland.....	1.5
Iberia.....	1.9	Grenada.....	2.9	Ozark.....	1.9	Sumter.....	1.6
Iberville.....	3.0	Hinds.....	3.2	Pemiscot.....	3.8	Williamsburg.....	2.1
Jackson.....	3.5	Holmes.....	*6.4	Ripley.....	3.3	TENNESSEE.	
Jefferson Davis... 1.6		Humphreys.....	*14.1	Scott.....	1.7	Benton.....	2.5
Lafayette.....	1.9	Issaquena.....	*10.5	Stoddard.....	4.7	Carroll.....	1.6
La Salle.....	*8.2	Itawamba.....	3.2	Wayne.....	2.3	Chester.....	3.0
		Jackson.....	1.6				

TABLE I.—*List of counties having a malaria mortality rate in excess of 1 per 10,000 population for the three-year period 1919–1921, indicating a moderate to high incidence of the disease for that period—Continued.*

TENNESSEE—continued.		TEXAS.		TEXAS—continued.		TEXAS—continued.	
County.	Rate.	County.	Rate.	County.	Rate.	County.	Rate.
Crockett.....	1.7	Anderson.....	1.5	Harris.....	1.5	Red River.....	2.0
Decatur.....	2.0	Austin.....	1.1	Henderson.....	1.1	Robertson.....	3.9
Dekalb.....	2.0	Bastrop.....	1.1	Hood.....	1.1	Rusk.....	1.3
Dyer.....	2.3	Bell.....	1.1	Houston.....	2.1	Sabine.....	1.6
Fayette.....	2.5	Bowie.....	2.8	Jackson.....	1.8	Starr.....	1.8
Franklin.....	1.5	Brazoria.....	1.5	Jefferson.....	2.5	Titus.....	2.8
Gibson.....	2.8	Brazos.....	4.1	Karnes.....	1.6	Tyler.....	1.9
Hardeman.....	2.3	Brooks.....	2.2	Lamar.....	1.3	Upshur.....	1.3
Hardin.....	2.3	Burleson.....	4.7	Lee.....	*7.1	Van Zandt.....	1.6
Haywood.....	2.0	Cameron.....	1.9	Leon.....	2.7	Victoria.....	2.2
Henderson.....	1.1	Chambers.....	4.8	Liberty.....	2.0	Waller.....	3.9
Henry.....	1.1	Cherokee.....	1.3	Limestone.....	2.1	Washington.....	1.9
Humphreys.....	1.5	Colorado.....	1.1	Madison.....	2.5	Williamson.....	1.2
Lake.....	2.2	Ellis.....	2.2	Marion.....	3.7	Wilson.....	1.2
Lauderdale.....	*7.9	Falls.....	1.4	McLennan.....	2.3	Wood.....	2.5
McNairy.....	2.7	Fannin.....	1.1	Milam.....	4.2		
Madison.....	1.4	Fayette.....	1.7	Montgomery.....	1.2	VIRGINIA.	
Marshall.....	1.7	Fort Bend.....	1.3	Morris.....	2.9	Greensville.....	2.7
Moore.....	2.2	Franklin.....	1.1	Nacogdoches.....	1.1	Isle of Wight.....	1.4
Obion.....	4.6	Goliad.....	2.1	Navarro.....	1.8	King George.....	1.7
Perry.....	1.3	Gonzales.....	1.4	Orange.....	1.3	King William.....	1.2
Shelby.....	1.2	Grimes.....	1.3	Panola.....	1.4	Nansemond.....	2.0
Tipton.....	*6.3	Guadalupe.....	1.4	Polk.....	3.0	Princess Anne.....	1.5
Weakley.....	1.9	Hardin.....	1.3	Rains.....	4.9		

TABLE II.—*List of counties having a malaria mortality rate in excess of 1 per 10,000 population for 1921, indicating a moderate to high incidence of the disease for that year.*

[The rates are based on the number of deaths during the year 1921 and the population figures given by the Bureau of the Census for 1920. Rates indicating a high incidence are marked by an asterisk (*).]

GEORGIA.		GEORGIA—continued.		GEORGIA—continued.		OKLAHOMA.	
County.	Rate.	County.	Rate.	County.	Rate.	County.	Rate.
Appling.....	2.8	Effingham.....	*6.0	Pierce.....	2.5	Adair.....	2.2
Bacon.....	1.5	Emanuel.....	3.5	Polk.....	1.5	Bryan.....	1.5
Baker.....	4.8	Floyd.....	1.8	Pulaski.....	3.5	Cherokee.....	1.5
Bartow.....	1.3	Glascok.....	*7.1	Rockdale.....	1.1	Choctaw.....	3.1
Ben Hill.....	1.4	Glynn.....	1.5	Randolph.....	3.0	Creek.....	1.9
Berrien.....	1.9	Grady.....	1.5	Richmond.....	1.9	Garvin.....	1.2
Bibb.....	1.3	Hancock.....	1.6	Schley.....	1.9	Johnson.....	2.0
Bleckley.....	*6.7	Haralson.....	1.4	Screven.....	4.2	Latimer.....	1.4
Brooks.....	*5.3	Houston.....	1.8	Sumter.....	*5.4	Le Flore.....	3.3
Bryan.....	4.8	Irwin.....	1.6	Taliaferro.....	1.1	McCurtain.....	*6.6
Burke.....	*7.1	Jefferson.....	3.1	Tattnall.....	2.8	McIntosh.....	1.5
Calhoun.....	4.9	Jenkins.....	*7.0	Telfair.....	1.3	Muskogee.....	1.8
Camden.....	*5.7	Johnson.....	4.5	Terrell.....	3.1	Nowata.....	3.1
Candler.....	1.1	Jones.....	1.5	Thomas.....	3.0	Oklfuskee.....	1.2
Charlton.....	4.5	Laurens.....	4.8	Toombs.....	2.2	Okmulgee.....	2.2
Chatham.....	2.0	Lee.....	3.7	Treutlen.....	3.9	Pontotoc.....	1.3
Clay.....	2.6	Lowndes.....	4.5	Turner.....	1.6	Pottawatomie.....	1.3
Colquitt.....	3.1	McIntosh.....	*8.0	Twiggs.....	1.9	Pushmataha.....	*7.4
Crisp.....	2.1	Macon.....	*5.1	Washington.....	2.8	Rogers.....	1.7
Dawson.....	2.4	Mitchell.....	2.7	Wayne.....	2.2	Sequoyah.....	1.1
Decatur.....	1.9	Monroe.....	1.5	Wheeler.....	4.1		
Dooly.....	2.0	Muscogee.....	1.4	Wilcox.....	2.6		
Early.....	*10.5	Oglethorpe.....	2.0	Worth.....	3.3		

The areas of high prevalence stand out as definite foci surrounded by larger areas of moderate prevalence. They are usually identified with the specially favorable topography offered by the broad flats

about the lower reaches of sluggish rivers. Particular note is made of the Pamlico Sound region of North Carolina; of the Savannah River region between South Carolina and Georgia; of the Flint River region in south Georgia; of the coast of west Florida about the mouths of the Apalachicola and Suwanee Rivers; and finally, and chiefly, of the great lower Mississippi River region with its broad flood plain, and the "delta" lands laid down by its changing course, and the extension, up the valleys, of its important tributaries—the Tennessee, the Arkansas, the St. Francis, the Black, and the Red Rivers.

No better evidence of the utility of mortality rates in indicating the distribution of the problem can be had than their agreement with

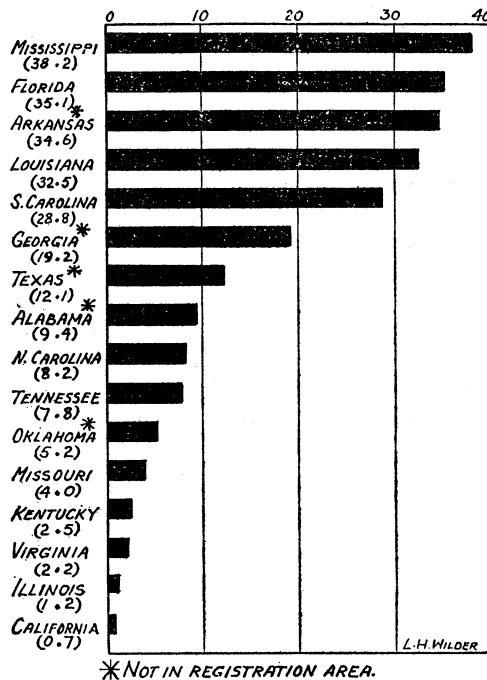


FIG. 2.—Crude death rates for malaria, 1920.

the topography which is known to be favorable to anopheline production, and hence, to malaria prevalence. It is noticeable, also, that when an area of high prevalence is indicated on the border of one State, it is generally matched by a similar area on the border of the adjacent State.

(B) THE RELATIVE IMPORTANCE OF THE PROBLEM IN EACH STATE.

In Table III and Figure 2 are shown the crude death rates from malaria in those States in which this disease is a more or less impor-

tant cause of death. Mississippi, Florida, Arkansas, Louisiana, and South Carolina stand out prominently at the top, as would have been expected from the data presented in the preceding paragraphs.

TABLE III.—Deaths and death rates from malaria for the years 1919–1921, inclusive, in those States in which this disease is an important cause of death.

State.	Number of deaths.			Crude death rate per 100,000. ¹		
	1919	1920	1921	1919	1920	1921
Alabama ² (total)	257	221	230	11.00	9.37	9.66
White	115	93	126	7.98	6.40	8.59
Colored	142	128	104	15.83	14.13	11.38
Arkansas ² (total)	367	610	999	21.05	34.63	56.13
White	235	373	637	18.46	28.99	49.01
Colored	132	237	362	28.09	49.90	75.44
California	23	24	43	6.83	.69	1.20
Florida (total)	417	344	231	43.56	35.11	23.06
White	241	195	120	38.20	30.21	18.18
Colored	176	149	111	53.90	44.60	32.49
Georgia ² (total)	363	559	468	12.60	19.21	15.92
White	135	242	195	8.03	14.25	11.37
Colored	228	317	273	18.99	26.14	22.28
Illinois	89	76	79	1.38	1.16	1.19
Kentucky (total)	73	60	84	3.03	2.47	3.45
White	56	48	70	2.58	2.20	3.18
Colored	17	12	14	7.22	5.07	5.88
Louisiana (total)	476	586	463	26.57	32.45	25.43
White	229	314	252	20.97	28.52	22.70
Colored	247	272	211	35.33	38.59	29.70
Mississippi (total)	653	683	963	36.46	38.15	53.81
White	207	190	321	24.23	22.25	37.61
Colored	446	493	642	47.61	52.64	68.58
Missouri	218	137	151	6.41	4.02	4.41
North Carolina (total)	201	210	172	7.91	8.15	6.58
White	81	84	75	4.57	4.68	4.12
Colored	120	126	97	15.59	16.14	12.25
Oklahoma ²	91	106	166	4.53	5.18	7.96
South Carolina	531	487	212	31.70	28.77	12.40
Tennessee	241	183	304	10.34	7.80	12.87
Texas ²	438	567	431	9.47	12.06	9.01
Virginia	69	51	34	3.00	2.20	1.45

¹ Computed on the basis of the population figures given by the Bureau of the Census for 1920 and estimated populations for 1919 and 1921.

² Not in the United States registration area for deaths; mortality figures taken from reports furnished to the United States Public Health Service by the State health officers.

Too much emphasis should not be placed upon small differences between States; there are factors which render close comparisons unreliable. One of the largest of these factors is the incompleteness of the mortality reports in those States not yet in the registration area. The influence of this factor may be partly overcome by expressing the number of malaria deaths in a ratio to the total number of deaths reported from all causes. This has been done in Table IV, and the comparison has been made still more specific by separating the figures for the cities (over 10,000) from those of the towns, villages, and country districts (rural population). A comparison of the mortality rate from malaria per 1,000 deaths from all causes reported in the rural areas only is shown for several of the States in Figure 3. In this comparison, Arkansas and Louisiana assume the leading position instead of Mississippi and Florida; the relative positions of the other States remain about the same.

This tabulation also brings out the fact that has long been known, namely, that malaria is essentially a rural problem. In spite of the tendency of the very sick malaria patients to drift into the hospitals

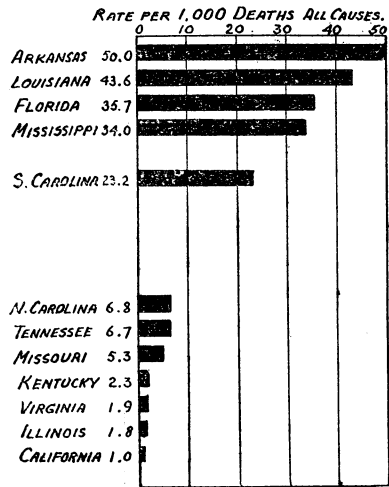


FIG. 3.—Malaria deaths per 1,000 deaths from all causes in the rural areas only of certain States, indicating the relative importance of the disease in those States.

of the large cities, there are apparently six times as many deaths from malaria in the rural districts as in the cities of the States here represented.

TABLE IV.—The relative importance of malaria as a cause of death in rural as compared with urban communities in certain States, 1920.¹

State.	Urban (cities of 10,000 or more).			Rural (towns and country districts).		
	Number of deaths.		Ratio. ²	Number of deaths.		Ratio. ²
	All causes (a).	Malaria (b).		All causes (a).	Malaria (b).	
Arkansas.....	2,734	40	14.63	11,410	570	49.96
California.....	28,157	6	.21	19,039	18	.94
Florida.....	3,720	23	6.18	9,000	321	35.67
Illinois.....	50,815	21	.41	31,481	55	1.75
Kentucky.....	6,867	6	.87	21,697	54	2.49
Louisiana.....	9,094	42	4.62	12,459	544	43.66
Mississippi.....	3,369	50	14.84	18,671	633	33.90
Missouri.....	20,481	20	.98	22,157	117	5.28
North Carolina.....	5,788	28	4.84	26,866	182	6.77
South Carolina.....	4,219	37	8.77	19,548	450	23.02
Tennessee.....	8,519	49	5.75	19,877	134	6.74
Virginia.....	9,024	11	1.22	21,490	40	1.86
Total.....	152,788	333	2.18	233,695	3,118	13.34

¹ Data for all States except Arkansas are taken from Mortality Statistics, 1920, published by the Bureau of the Census. Figures for Arkansas were furnished by the State board of health of that State.

² Ratio is expressed as the number of deaths from malaria per 1,000 deaths from all causes.

It has been noted in the previous section that malaria in these States is not uniformly distributed, even in the rural areas; it is more or less sharply confined to certain sections of the rural areas of each

State. Any comparison of the relative importance of the malaria problem should take cognizance of this fact. It should show how much of the State is affected by a high or moderately high prevalence of this disease, and how fatal the disease is in this area. An attempt has been made to express such a comparison in Table V and Figure 4. The basis of the comparison is the same as that used in the preceding section, i. e., a county with an average death rate from this disease of more than 1 per 10,000 population over a three-year period may be reasonably supposed to have a real problem. In column (b), Table V, is shown the percentage of the total number of counties in each State that have such a problem, and in column (d) the ratio of the population of these counties to the total population of the State. In the last column is shown the malaria death rate based on the number of deaths from malaria in and the population of these counties in what might be called the "malaria belt" of the State.

These comparisons emphasize the position of four of the States mentioned above—Mississippi, Florida, Arkansas, and Louisiana. Georgia, South Carolina, and Texas seem to be in an intermediate class. Alabama, Tennessee, Oklahoma, and North Carolina have a large problem, but it affects less than one-half of their territory and people. Finally, Missouri, Kentucky, Virginia, Illinois, and California have their malaria apparently confined to very limited areas. The data again indicate the wide distribution and severity of malaria in the Mississippi Valley and west Florida.

TABLE V.—*The relative importance and intensity of the malaria problem in certain States compared, using for comparison only those counties having a death rate from this disease of over 1 per 10,000 population.*

State.	Counties involved.		Population involved.		Deaths from malaria, 1919-1921.	
	Number.	Per cent of total.	Number.	Per cent of total.	Average annual number.	Average annual rate per 100,000. ¹
	(a)	(b)	(c)	(d)	(e)	(f)
Alabama.....	29	43	864,408	37	155	1.80
Arkansas.....	52	69	1,321,402	75	639	4.84
California.....	4	7	37,341	1	9	2.41
Florida.....	41	76	771,304	80	329	4.27
Georgia.....	70	45	1,386,124	48	400	2.89
Illinois.....	9	9	183,496	3	37	2.02
Kentucky.....	6	5	119,192	5	29	2.43
Louisiana.....	55	86	1,285,524	71	486	3.78
Mississippi.....	74	90	1,645,716	92	763	4.64
Missouri.....	11	10	218,397	6	99	4.53
North Carolina.....	26	26	609,241	24	150	2.46
Oklahoma.....	20	26	638,023	31	145	2.27
South Carolina.....	26	57	894,142	53	233	2.61
Tennessee.....	27	28	773,811	33	168	2.11
Texas.....	64	25	1,839,780	39	348	1.90
Virginia.....	6	6	74,355	3	13	1.75

¹ The average annual number of deaths occurring in those counties (in each State) which have an average rate of more than 1 per 10,000 (column (e)) and the total population of these counties according to the 1920 census (column (c)) are the figures on which the death rates (column (f)) are computed.

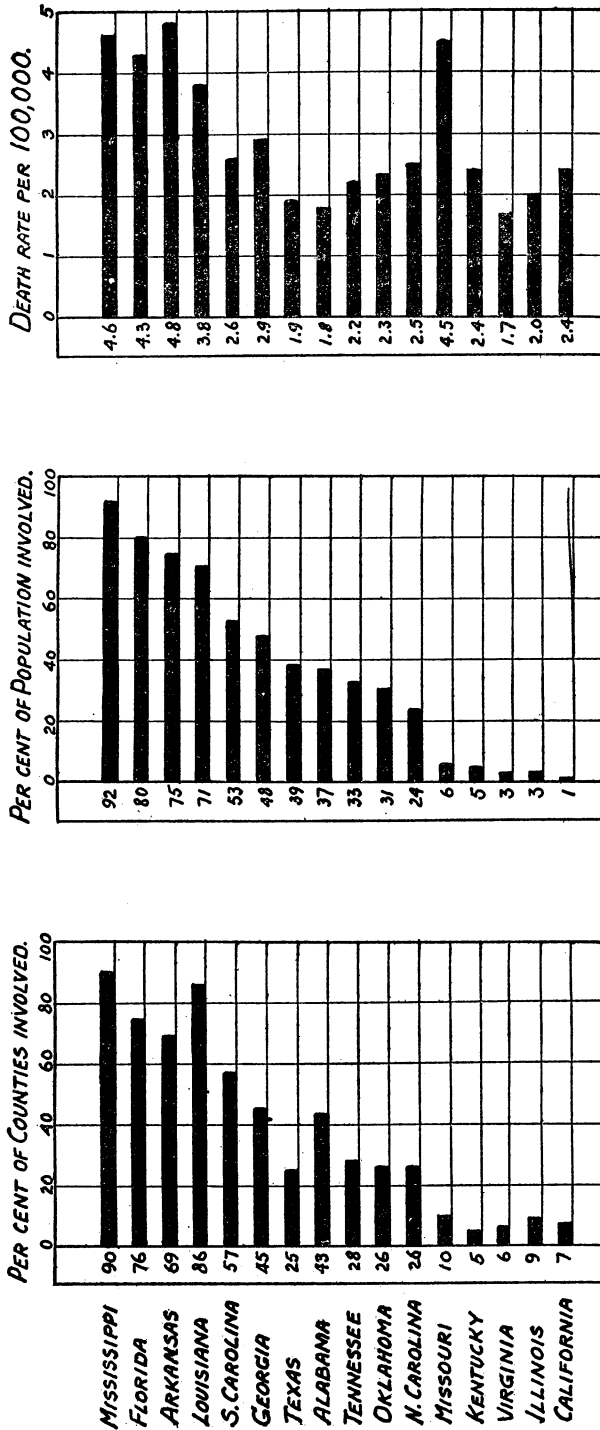


FIG. 4.—Showing for certain States the per cent of counties having a malaria death rate greater than 1 per 100,000 population for the period 1919-1921, the ratio that the population of these counties bears to the total population of the State, and the malaria death rate based upon the number of deaths and the population in these counties only.

(C) THE NATURAL TREND OF THE DISEASE IN EACH STATE.

There is a general impression that malaria in the United States is on the decline. There is no doubt that the northern border of the "malaria belt" has been retreating. The disease has practically

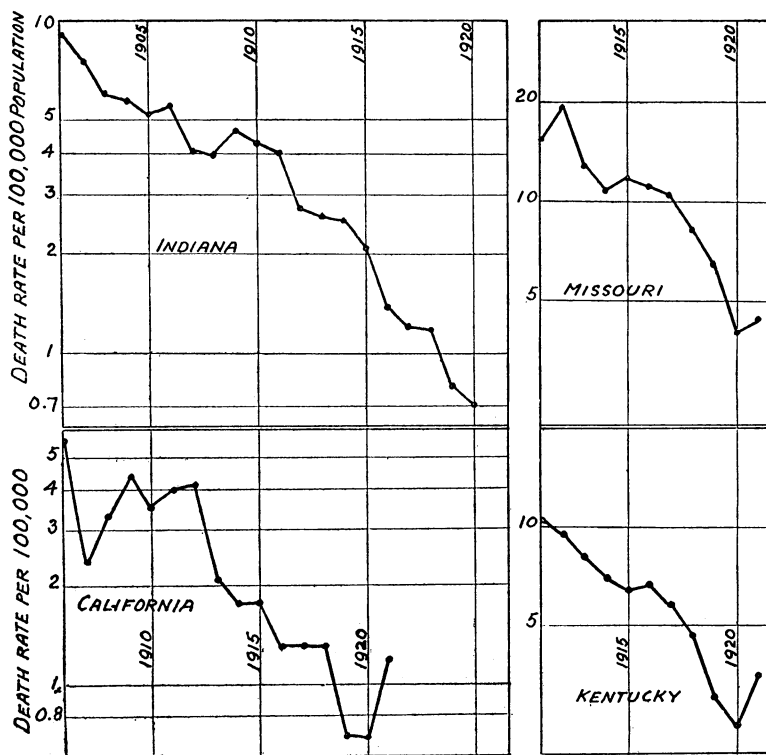


FIG. 5.—Trend in the crude death rate for malaria in Indiana, Missouri, California, and Kentucky. (According to Mortality Statistics, Bureau of the Census.)

disappeared from Maryland in the past 20 years, although there was a slight flare-up during the summer of 1922. The course of events in Virginia, Indiana, Missouri, and Kentucky is indicated by the accompanying graphs, based on the death rate. California, which has a malaria problem peculiar to itself, also shows a steady decline.

Figure 6, showing the trend of malaria mortality in four of the South Atlantic States, is based on the white population only. This is perhaps a little more dependable than a crude rate including colored persons. There seems to be no question about the downward tendency of malaria prevalence in Virginia and Florida, but in the Carolinas the rate has apparently been practically stationary during the past four years.

A different picture is presented on plotting similar data for the three Mississippi Valley States—Mississippi, Louisiana, and Arkansas—two of which show a significant increase in 1921. Part of the increase in Arkansas is undoubtedly due to better reporting, this State not

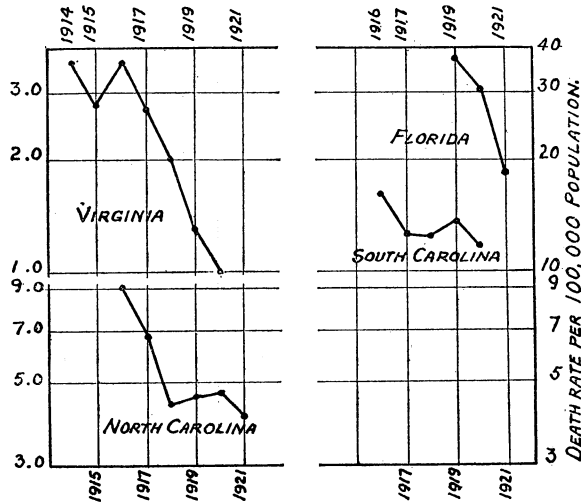


FIG. 6.—Trend of death rate for malaria among white persons only, in four South Atlantic States. (According to Mortality Statistics, Bureau of the Census.)

yet being in the registration area for deaths. From Table III it will be seen that a similar increase in deaths from malaria was also registered in 1921 in Kentucky, Missouri, and Tennessee. This increase in the malaria death rate in all these States is worthy of attention.

Undoubtedly some of the decline in the number of deaths attributed to malaria in the past few years is due to better diagnosis. It is only within the last 10 or 15 years that the use of the clinical laboratory has become sufficiently widespread to act as a check on the diagnosis of "bilious," "remittent," and "intermittent" fevers, and to confine the diagnosis of malaria more closely to the specific infection with the protozoan blood parasite. There is admittedly still much room for improvement, particularly in the remote rural areas where laboratory facilities are not at hand.

Improvement in diagnosis, however, can not account for all or nearly all the decline. One finds almost universal testimony in the field that malaria is growing less common and less severe in most parts of this country. Cases of malarial hemoglobinuria or "black-water fever" are becoming rare. One has no difficulty in finding county after county and town after town, particularly in the States along the northern border of the "malaria belt" and along the Atlantic and Gulf coasts, where the oldest inhabitants tell of the

widespread prevalence of malaria in former years, but where to-day it is difficult to demonstrate a single autochthonous case.

On the other hand, there are undoubtedly certain areas remaining in which it is hard to see any material improvement in the malaria

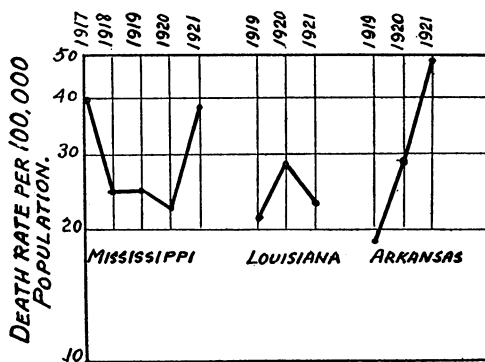


FIG. 7.—Trend of death rate for malaria among white persons only, in three States in the Mississippi Valley. (Based on Table III.)

situation in recent years. The increase in prevalence in the lower Mississippi Valley in 1921, indicated above, suggests that an uninterrupted decline is not to be expected in this section without more extensive and effective effort at control.

SUMMARY.

This study of mortality rates from malaria indicates that the disease is largely confined to the Coastal Plain, reaching its widest distribution in the lower Mississippi Valley. The distribution of the disease is not uniform, but focal in character. Areas of high prevalence are found chiefly about the mouths of large rivers along the coast, particularly in the "delta" lands of the Mississippi and along the valleys of its large tributaries.

In Arkansas, Louisiana, Mississippi, and Florida a large proportion of the total land area and population is affected by the malaria problem. In the other States in the South the problem is more or less limited to certain sections of each State, the remainder of the State being relatively or entirely free from the disease.

While there has been a general decrease in incidence of the disease in the past few years, this does not hold for all parts of the country. Mortality records indicate a definite increase in incidence for the Mississippi Valley during the year 1921.